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DETERMINATION OF THE SONOLITH R VISION LITHOTRIPTER EFFICACY FOR THE SOLITARY URINARY STONES MANAGEMENT

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Abstract:

Objective: *The objective of the study is to assess the outcomes of ESWL for urinary stones using the Sonolith R vision lithotripter.*

Place and Duration: *In the Urology Unit II of Mayo Hospital Lahore for one year duration from March 2019 to February 2020.*

Patients and methods: *463 patients were analyzed retrospectively, including 451 patients aged 18 to 93 (mean 56.32 years) of which 62% of men and 38% of women experienced ESWL for solitary urinary stones at the lithotripsy unit. The most common ureter locations were 98 distal (lower) ureter patients (52%), and the most common kidney locations were 126 renal pelvis (46.49%). The mean diameter of the stone was 1.41 cm (1.02 ureteral and 1.8 cm kidney). 56% of patients received ESWL under cover of pethidine IV diluted 50 mg as sedation.*

Results: *Our 463 patients required a whole of 672 meetings of ESWL. The average number of meetings per calculation was 1.425 (range 1-6). The % of patients requiring a sole session was 72.3%. The re-treatment rate was 25% for ureteral stones and 32% for kidney stones. Treatment was more operative on ureteral stones. Other supportive procedures such as DJ stent placement and ureteroscopy were needed in 56 (12%) patients.*

Conclusion: *As a result, we originate that Sonolith R's vision is a safe and operative device for treating urinary stones in selected patients.*

Keywords: *Extracorporeal Shock Wave Lithotripsy, Sessions, Indicator Without Stones.*

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INTRODUCTION:

ESWL is the treatment of choice for most urinary stones. The shockwave application for the treatment of urinary stones was first used by Christian Chaussy in 1982. Since then, there has been significant progress in ESWL machines with various modifications in the production of shock wave focal length, terminal setting methods and urolithiasis location methods [1-2]. All these changes affected the lithotripter breaking capacity. There are three main types of shock wave generators: spark gap (electrohydraulic), electromagnetic and piezoelectric [3]. Spark gaps and electromagnetic lithotriptors are the most common, the piezoelectric system provides insufficient power and hinders the effective breaking of urinary stones. Spark lithotripters generate shock waves, releasing a high voltage discharge from two electrodes immersed in water [4]. There are many factors that affect SWL efficiency, such as shockwave pressure, frequency, and target area size. To break a stone, energy must be concentrated at a certain point obtained by focusing on shock waves [5]. When the shock waves are not focused, fragmentation only occurs using a very high energy level, which causes damage to surrounding tissues and increases the risk of harmful side effects [6].

The focus of shock waves is achieved by a reflective acoustic lens and depends on two variables, the size of the focus and the focusing field6. The surface of the shockwaves depends on the width of the reflector and the surface of the body in which the shockwaves pass before reaching the stone. Generally, a larger hole results in less pain8. Breaking stones with shock waves is done by combining the following mechanisms. Compression due to spallation voltage and tension, cavitation, wave propagation and dynamic fatigue.

PATIENTS AND METHODS:

This study was held in the Urology Unit II of Mayo Hospital Lahore for one year duration from March 2019 to February 2020. 463 patients were analyzed retrospectively, including 451 patients aged 18 to 93 (mean 56.32 years) of which 62% of men and 38% of women experienced extracorporeal shock wave lithotripsy for solitary urinary stones at the lithotripsy unit. ESWL was performed by 3 urologists, supervised by an urologist consultant. The lithotripsy device used was Sonolith R Vision (Technomed Medical System Vaulx-en-velin France). This machine produces shock waves using an electrically conductive shock wave generator with an elliptical reflector specifically designed for maximum energy concentration in the stone. It has a field of view with 3.6 x 25 mm focal length of 20 J with an opening angle of 80 x and an aperture diameter of 219 mm. All patients underwent detailed medical history and routine tests, including CBC, glycemic profile, RFT, LFT, C / E urine, C / S urine and coagulation profile. Patients were diagnosed with conventional methods, such as a simple X-ray of KUB, IVU, and ultrasound or computed tomography. The stone size was the maximum diameter observed on the flat x-ray of the abdomen before treatment. Patients with urinary tract infection were treated with appropriate antibiotics according to the C / S urine score before ESWL. DJ stents were placed before ESWL in patients with stones larger than 2.7 cm.

Exclusion criteria:

- Patients with multiple radioactive stones and stones were excluded from the study (only radiopaque stones were included).
- Patients with stones 3 cm or higher were also excluded. They had an open surgery or were directed to a higher PNL center.
- Patients with coagulopathy or anticoagulant therapy were excluded from the study.
- All cardiologic patients with active heart disease were excluded from the study.

Patients were sedated before or during the treatment procedure using a 50 mg intravenous injection of pethidine depending on the conditions. All patients were treated with C-arm and stone fragmentation was observed during the C-arm procedure. The ESWL session was repeated at least two weeks apart (2-4 weeks). A week after treatment, a KUB radiograph and abdominal ultrasound were performed to confirm the presence of the hematoma and assess lithiasis. The protocol used was in situ lithotripsy to treat stones, use the number of sessions required to obtain fragments smaller than 2-3 mm, or eliminate urolithiasis. All treatment sessions were carried out in accordance with OPD. Only patients requiring a DJ or patients with ESWL complications were accepted. The energy level used for ESWL sessions varies from 15k.v to 19k.v depending on patient tolerance.

The ESWL session consisted of 3,000 to 4,000 shockwaves.

RESULTS:

The study involved 463 patients. 287 (62%) patients were male and 176 (38%) patients were female. The age range is 18–93 years (average 56.32 years). The calculations are on the right in 46% (213) cases, and on the left in 54% (250) cases. The average diameter of the stone was 1.253 cm (range from 0.4 to 3 cm).

The local kidney was 271 (58.53%) and the ureter 192 (41.46%) cases.

Table I: Stone Size and Percentage of Distributors

Size cm	=n	%age
<0.5	55	12
>0.5 <1	38	8.4
1	2.3	46
>1 <2	98	21.16
2	38	8.3
>2<3	21	4.5

Table II: Stone location and percentage of distribution (n=463)

Location	=n	Total %	Partial %
Renal	271	58.53	
Renal Pelvis	126	27.2	46.49
Inferior Calyx	28	6.04	10.33
Middle Calyx	35	7.55	12.91
Lower Calyx	82	17.71	30.25
Ureteral (on IVP)	192	41.46	
Upper Ureteral Anatomical (from PUJ to lower border of kidney)	59	12.74	30.72
Mid Ureteral (from lower border of kidney to lower border of sacro – iliac joint)	35	7.55	18.22
Lower Ureteral (from Lower border of sacro – iliac joint to ureterovesical junction)	98	21.16	51.04

Our 463 patients had to undergo a total of 672 ESWL sessions. The average number of meetings per calculation was 1425 (range 1-6). The % of patients requiring a single meeting was 72.3%. Less than 2 sessions needed in 78.4%, less than 3 sessions in 86.04%, and only 3% of patients needed 4 or more sessions to break the stone. There was a difference between mean shock wave lithotripsy depending on the size of the stone. For stones smaller than 1 cm. The regular number of sessions was 1.231, 1.35 for 1 cm of stone and 2.05 sessions for 2 cm of stone. The average number of sessions increases with increasing stone size. The percentage of patients without stones with only one session gradually decreased depending on the size.

Table III: Average sessions of Lithotripsy and stone free rate at first and second session

Size	=n	Average Session	First Session%	Second Session
<0.5	55	1.12%	92.30%	96.40%
>0.5 <1	38	1.23%	82.50%	91.20%
1	213	1.35%	73.50%	94.30%
>1 <2	98	1.57%	65.30%	83.70%
2	38	2.05%	47%	78.30%
>2 <3	21	2.83%	39%	72.50%

Of the total number of 463 patients 58.53% (271) of kidney stones, about half of these kidney stones were 126 (46.49%), 192 (41.46%) ureters, and the ureter stones had 98 (51.04%) in the renal pelvis. The average number of sessions per ureter stone was 1.27 and the kidney stone was 1.58. The re-treatment rate was 25% for ureter stones and 32% for kidney stones. The results show that the treatment of ureter stones is more effective, but the size of the stone was also a factor in the outcome (the average size of the kidney-producing ureter stone compared to 1.44 cm is 1.06 cm).

Table IV: Size, average sessions and percentage of stone free rate with one or two sessions depending upon stone location

Location	Size (in cm)	No	Average Session	First Session	Second Session
Total	1.253	463	1.43%	72.30%	84.45%
Ureteral	1.06	192	1.27%	76.50%	92.40%
Renal	1.44	271	1.58%	68.32%	83.40%

Sedation:
220 patients (47.5%) required sedation of 50 mg diluted pethidine IV during surgery. Other patients tolerated the treatment well.

Use of other supportive procedures:
Other supportive procedures were required in 56 (12%) patients. Twelve (2.59%) patients with kidney stones approached 3 cm (2.7 - 2.9 cm.) DJ stent was placed in front of ESWL. Stents were removed when the patient had no stones. Forty (8.6%) patients underwent ureteroscopy and endoscopic retrieval of stone fragment with basket and forceps in cases of stein stressae and obstructed ureteral fragments. Two (0.45%) patients with 2.8 and 2.9 cm kidney stones underwent open surgery according to their wishes after ESWL was ineffective after the DJ stent was placed. PNL configuration was not available. Ureterolithotomy was performed on a patient (0.215%) with lower ureteral stone less than 2.3 cm due to obstruction and ineffective ESWL. One patient with kidney stones developed obstruction and fever after ESWL, percutaneous nephrostomy, and then ESWL.

Table V: Auxiliary maneuvers and percentage

Maneuver	=n	%age
Total	56	12
DJ stents	12	2.6
Ureteroscopy	40	8.6
Pyelolithotomy	2	0.43
Ureterolithotomy	1	0.21
PCN (Percutaneous Nephrostomy)	1	0.21

After ESWL we achieved a stone less index of less than 90% in ureteral stones and over 80% of renal stone residue.

DISCUSSION:

Since the first definition of ESWL urinary stone therapy in 1982, extracorporeal lithotriptors have become more effective at lower morbidity and lower costs. Initially, the energy used was electrohydraulic, but today electromagnetic shock waves are preferred, because the energy here is easier to control, the energy ratio is more stable and causes less pain to the patient due to the larger area of application9. The disadvantage of electromagnetic waves is the high concentration of energy in the small focus area, which increases the risk of kidney damage (bruising) and reaches 4%. In our study, no patient developed this complication because Sonolith R Vision increased the focus area to 3.6 x 25 mm to reduce this complication.

More than half of our patients tolerated the treatment well .Only 270 (47.5%) patients required sedation with IV Pethiidne. Sonolith R Vision seems to strike a good balance between analgesic needs and rate of effectiveness of stone fragmentation.

In our study, the number of ESWL sessions for stone in the treatment of urinary stones was 1425. This is a relatively high percentage compared to other studies, which range from 1.2 to 1.4 sessions for urolithiasis, based on the average size of stones10. The difference can be multifactorial. One factor may be the electrode life. In our research, it has been observed that as the electrode ages, its performance decreases, performance drops significantly after 35,000 shock waves are delivered, and we use most electrodes beyond this turning point. This factor may be responsible for a relatively high urolithiasis session in our study. In other studies, the rate without stones ranges from 68% to 86%. In our study, the indicator without stones was over 90%. In our study, the percentage of re-treatment is 25% for ureter stones and 32% for kidney stones, which is higher than in other studies11. The rate without stones is similar to the most effective lithotripter (HM3), but more sessions have this drawback. This suggests less effectiveness, less need for anesthesia, use of outpatient procedures, but greater effectiveness in our study, which is disadvantageous when more sessions are needed12. Another factor affecting treatment sessions was the lack of lymphoclasts and PNL in our hospital, and the only treatment method for ESWL urinary stones13. Finally, a high percentage of limestone (30.25% of all kidney stones) contributed to the surge in the number of meetings and the stone withdrawal rate. The percentage of patients who required an further procedure in our study was 12%, which is justified because we made a cautious selection of patients, and kidney stones of 3 cm or more were not exposed to ESWL14-15. We used DJ stents before ESWL in patients with high stone load> 2.7 <3 cm to prevent complications such as Steinstressae, ureter obstruction and pain after ESWL, but this reduced the efficacy ratio, but relatively low in our population, as acceptance of complications patient, which means it routinely offers safe and expensive treatment.

CONCLUSIONS:

Our experience with Sonolith R Vision has shown that this device is safe and although our average number of sessions per stone is slightly higher than in other studies compared to the size of the stones, we have achieved very good results with a large amount of free stones recently. This leads to the conclusion that lithotriptors with electromagnetic shock will become the gold standard for lithotripsy in the future.

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